

Computer Graphics

50:198:456/56:198:556 (Spring 2009)

Handout:	1	Professor:	Suneeta Ramaswami
Date:	1/26/09	E-mail:	rsuneeta@camden.rutgers.edu
Office:	321 BSB	URL:	http://crab.rutgers.edu/~rsuneeta
		Phone:	(856)-225-6439

Course Outline

Course Summary:

This is an introductory course on computer graphics in which you will learn about the mathematical foundations of the field, and also gain significant experience in graphics programming. The goal of this course is to thoroughly understand the fundamentals of graphical systems and, at the same time, develop sophisticated graphics programs by using a powerful programming package. In particular, you will use OpenGL, a platform-independent graphics library, and the industry standard for graphics programming. Since OpenGL is platform-independent, an interface with the windowing system is needed to display the results of the graphics program: GLUT (Graphics Library Utility Toolkit) is a toolkit that provides window management and user-interaction facilities. Therefore, you will use GLUT along with OpenGL.

The topics that will be covered during the course are the following (a more detailed schedule of topics to be covered appears at the end of this handout): Graphics systems and imaging principles, graphics programming using OpenGL and GLUT, input devices and interactive techniques, geometric transformations and modeling in two and three dimensions, viewing in 2D and 3D, lighting and shading, and fundamental graphics algorithms (clipping, hidden surface removal, scan conversion and anti-aliasing). Time permitting, we will also cover selected topics on curves and surfaces, and solid modeling. We take a top-down approach to learning about graphical systems: we discuss three-dimensional graphics at a high level fairly quickly, and then move on to the lower-level tools that are needed to implement a graphics system. To understand the theoretical material in this course, you will need some background in discrete mathematics, data structures and basic algorithms. While we will learn the fundamentals of OpenGL and GLUT, we won't have time to cover all the features in great detail in class. It is expected that you will explore these packages on your own as well.

All course material will be made available at the course web page. Other useful and interesting course-related links will also be made available at that site. In particular, links to the GLUT documentation and the online OpenGL Programming Guide can be found there. Please bookmark this page (<http://crab.rutgers.edu/~rsuneeta/cgs09/>) in your web browser.

Pre-requisites:

Programming with Data Structures (50:198:113). **It will be assumed** that you are comfortable programming with data structures. Please see me if you do not have the necessary pre-requisites. I will use C and/or C++ in class for the program demos. You may use another programming language, with the stipulation that I am able to compile and run the programs on my laptop.

Text Books:

1. Required: *Interactive Computer Graphics: A Top-down Approach with OpenGL*, by Edward Angel, 4th Edition, 2006, Addison-Wesley (ISBN 0-201-38597-X).
2. Recommended: *OpenGL: A Primer*, by Edward Angel, Addison-Wesley (ISBN 0-201-74186-5).
3. Recommended: *OpenGL Programming Guide* by Shreiner, Woo, Neider, and Davis, 5th Edition, 2005, Addison-Wesley (ISBN 0-201-60458-2). This book is a comprehensive resource on OpenGL and also covers some topics in computer graphics. Some of the material in the Programming Guide is available online (the link can be found at the course web page).
4. Supplementary: The complete GLUT documentation can be found online in either HTML or postscript format. Please follow the "GLUT Documentation" link at the course web page. Also, the Programming Guide discusses GLUT briefly.

Office hours:

Tuesdays, 11AM-1PM, or by appointment at a mutually agreeable time.

Coursework:

1. Four Programming Assignments, worth a total of 45% (5% for #1, 10% for #2, 15% for #3, and 15% for #4)
2. Two Written Assignments, worth 5% each
3. In-class Exam, worth 20% (tentatively to be held in class on March 11, 2009).
4. Final Exam, worth 25% (to be held on Saturday, May 9, 2009 from 2:00 to 4:00PM).

The written assignments cover mathematical aspects of the course. The programming assignments cover significant topics in the course and require the use of OpenGL.

Tentative dates for Assignments:

Prog #1:	Out 1/26, Due 2/11	Prog #2:	Out 2/11, Due 3/4
Prog #3:	Out 3/4, Due 4/1	Prog #4:	Out 4/1, Due 5/4
Written #1:	Out 2/16, Due 3/2	Written #2:	Out 4/8, Due 4/27

Grading Policy:

General discussion of homework assignments with fellow students is fine. However, *all work must be done independently*. Please respect this policy - this will allow each of you to receive full credit for the creativity I hope to see in your homework assignments.

Homework assignments **must** be submitted on the due date. Late hand-ins will be subject to a 20% deduction per day after the due date.

Please make sure that your homework assignments compile and run successfully before submitting them.

Tentative Schedule of Topics to be Covered:

Dates	Topics	Reading
1/26	Overview of Graphics Systems - Applications, Interactive Graphics - Hardware/Software, Graphics Architecture -Imaging Principles	Ch. 1 of Angel
1/28-2/2	Graphics Programming - Introduction to OpenGL - Introduction to GLUT - Sample Programs	Ch. 2 of Angel OpenGL/GLUT Handout Chs. 1 & 2 of Prog. Guide (as necessary) GLUT documentation
2/4	Input and Interaction - Input Devices - Display lists - Callbacks, menus - Sample Programs	Ch. 3 of Angel Ch. 7 of Prog. Guide(as necessary) GLUT documentation
2/9-2/16	Geometric Transformations, Modeling - Matrix Representation of 2D and 3D Transformations - Translation, Rotation and Scaling - Homogeneous Coordinates - Concatenation of Transformations OpenGL Implementation of Transformations, Sample Program	Ch. 4 of Angel Ch. 3 of Prog. Guide (as necessary)
2/18-2/25	Viewing in 2D and 3D - Camera Positioning, Orthographic & Perspective Projections - Normalization - OpenGL Implementation, Sample Program	Ch. 5 of Angel Ch. 3 of Prog. Guide
3/2-3/9	Lighting and Shading - Light sources, Illumination models - Phong Reflection Model - Flat/Gouraud/Phong Shading - Specifying material properties in OpenGL, Sample Program	Ch. 6 of Angel Chs. 4, 5 of Prog. Guide
3/11	In-class Exam I	All material covered upto 3/2
3/23-4/1	Low-level Algorithms - Clipping in 2D & 3D - Hidden-surface Removal - Scan Conversion and Anti-aliasing	Ch. 7 of Angel
4/6-4/15	Using Images - Bit and Pixel Operations in OpenGL - Texture Mapping - Compositing Techniques	Ch. 8 of Angel
4/20-4/27	Ray Tracing	handout
4/29-5/4	Curves and Surfaces (time permitting)	Ch. 11 of Angel